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165/42

986663 COMPLETE SPECIFICATION

1 SHEET

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FIG.1.

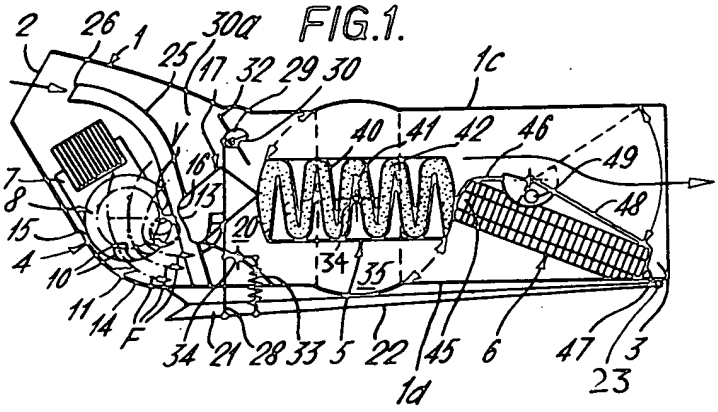
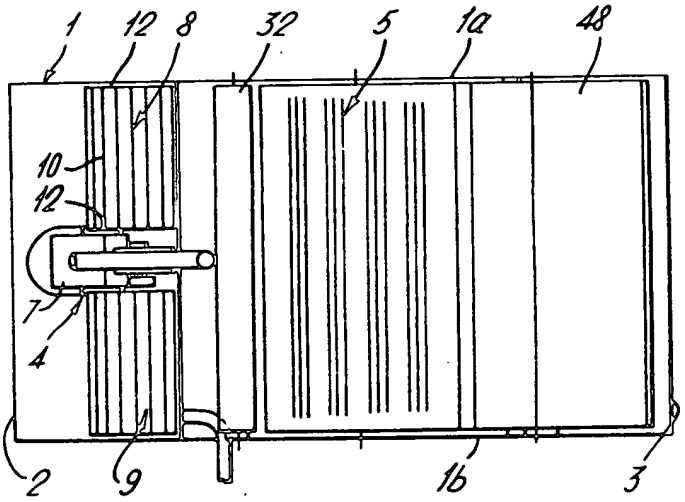


FIG.2.



986,663

PATENT SPECIFICATION

DRAWINGS ATTACHED

986,663

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No. 47415/64.

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Int. Cl.:—F 24 f

COMPLETE SPECIFICATION

Improvements relating to the Air Conditioning and Heating of Vehicles

We, FIRTH CLEVELAND LIMITED, a British Company, of Stornoway House, Cleveland Row, St. James's, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to heater/air-conditioner units for vehicles.

The invention provides a heater/air-conditioner unit comprising a housing having an inlet to face forwardly of the vehicle; an outlet for supply of air to the interior of the vehicle; a heat exchanger for heating air flowing between inlet and outlet; a fan in the housing; a by-pass past the fan; and flow control means in the housing sensitive to ram air pressure and effective, when the ram air pressure is zero, to block the by-pass and permit flow through the housing on operation of the fan, and, when the ram air pressure rises, to open the by-pass and permit flow through the housing by reason of ram air pressure.

The invention will be further described with reference to the accompanying diagrammatic drawings wherein one embodiment of the invention is illustrated by way of example. In the drawings:

Figure 1 is a longitudinal section of a car heater air-conditioner unit; and

Figure 2 is a plan view of the Figure 1 unit with the top of the housing removed.

Referring to Figures 1 and 2 of the drawings, the car heater air-conditioner unit thereshown comprises a more or less box-shaped housing 1 having generally parallel side walls 1*a*, 1*b* and top and bottom walls 1*c*, 1*d*. The housing is open at its front and rear ends as shown to provide an inlet and an outlet 2, 3 respectively. At all points along the general direction of air flow through the housing 1, the cross-section of the housing transverse to flow is substantially rectangular. The front opening or inlet 2 of the unit is intended to face forwardly of the car so that air enters this inlet when the car is moving. The unit includes three main elements, a fan designated generally 4, a filter designated generally 5 and a heat exchanger designated generally 6, these elements being arranged in the order given, going from front to rear. In addition the heating unit includes flaps for the control of flow therethrough, as will be described later.

The fan 4 comprises a small narrow electric motor 7 arranged centrally of the unit with its shaft (not shown) extending transversely thereof. The motor shaft carries similar cylindrical bladed rotors 8, 9 each extending between one side of the motor and the adjacent side wall 1*a*, 1*b* of the unit. As shown in Figure 1 each rotor 8, 9 comprises a series of blades 10 extending parallel to the rotor axis, being concave facing the direction of rotation indicated by the arrow 11, and having their outer edges leading their inner edges. The blades are mounted between end discs 12 shown in Figure 2 and co-operate with guide walls 13, 14 to induce flow through the rotor. The guide wall 13 is short and converges with the rotor in the direction of rotor rotation, being concave thereto. The guide wall 14 lies opposite the guide wall 13 and diverges from the rotor with steadily increasing radius and curvature starting at the line of nearest approach indicated at 15. The line 15 is approximately opposite the line 16 of nearest approach of the guide wall 13 to the rotor: at both these lines the guide walls 13, 14 are spaced by more than a working clearance from the rotor and the guide wall 15 may be spaced by one third to one half of the radial blade depth, or more. The guide wall 13 is the bight part of a U-shaped baffle indicated generally at 17 which extends across the whole

[*Price 4s. 6d.*]

width of the housing 1. The guide wall 14 is part of the bottom wall 1*d* of the housing where it curves up towards the inlet 2. One limb of the baffle 17 co-operates with part of the base of the housing 1 further towards the rear to provide a diffuser 20 through which the air leaving the rotors passes.

In operation a vortex is set up having a core adjacent the guide wall 13 and indicated by the chain dotted flow lines V. The flow takes place through the rotor as shown by the chain dotted flow lines F and the pressure at outflow is increased in the diffuser 20. The design and construction of the fan, more particularly the rotors and guide walls 13, 14, follows the principles enunciated in the specification of our copending application for Letters Patent No. 20871/57 (Serial No. 876,611), which should be referred to. This specification also describes in more detail how the flow takes place.

Below the bottom wall 1*d* of the housing 1 is situated a bellows 21 having a bottom plate 22 co-operating with the bottom wall of the housing and pivoted transversely thereto at 23 adjacent the rear end 3 of the housing. A tube 25 located centrally of the housing presents an open end 26 opposite about the middle of the inlet 2 and conveys pressure to the interior of the bellows 21. It will be appreciated that this tube 25 acts in the manner of a Pitot tube: that is to say, as the car travels more rapidly, the velocity of the air entering the opening 2 increases and the pressure within the bellows 21 also increases. A cord 28 unwinding from a cam 29 mounted on a transverse spindle 30 is connected to the bottom plate 22 of the bellows 21. A butterfly valve 32 mounted on the spindle 30 controls the by-pass duct 30*a* formed between the baffle 17 and the top of the housing 1, this duct receiving air from the inlet 2. As the velocity of air entering the inlet 2 increases the bottom of the bellows 22 descends and the butterfly valve 32 opens. A further butterfly valve 33 is mounted upon a transverse pivot axis shown at 34 in the diffuser 20 and connected by a spring mounted at the bottom of the bellows so that as the butterfly valve 32 opens, the butterfly valve 33 closes the air passage through the diffuser 20. It will be seen that by suitable shaping of the cam 29 any desired relation between the passage which is presented by the butterfly valves can be obtained.

Air which has passed either of the butterfly valves 32 and 33 then passes through the chamber 35 wherein is located the filter 5.

The filter 5 comprises a pair of perforated sheet elements 40, 41 which extend between the side walls 1*a*, 1*b* of the housing 1, which are pleated, and between which is contained granular carbon 42 or other active material. The filter 5 forms a unit and is pivoted to the side walls of the housing on a transverse pivot axis shown at 34. The filter 5 is adapted for manual control by means of a knob or lever (not shown) located on the outside of the housing.

The heat exchanger 6 takes the form of a perforated rectangular block mounted at the rear of the housing 1, extending the width thereof and running obliquely downwards to the bottom of the housing with its front end 45 midway between the top and bottom of the housing and just touching one end of the filter 5 when the latter is pivoted to the horizontal position as shown. The front end 45 of the heat exchanger block 6 is covered by an insulated baffle 46, and the rear end by an insulated baffle 47; thus air can only flow through the thickness of the block. The baffle 46 pivotally mounts a flap valve 48 which is insulated on the side away from the heat exchanger (*i.e.* the downstream side).

It will be seen that when the flap valve 48 assumes the position shown in full lines, none of the air leaving the housing through the opening 3 is heated by the heat exchanger. When the flap valve 48 assumes the position shown in dotted lines, all the flow takes place through the heat exchanger. At intermediate positions of the flap valve 48 the flow is partly heated and partly unheated. The insulation on baffles 46, 47 and flap valve 48 minimize leakage of heat to the outflow when the flap valve is closed. To further reduce this leakage small holes 49 are formed leading to the exterior of the housing from downstream of the heat exchanger block, so as to prevent a return flow of air through the heat exchanger.

Any desired relation between the movements of the butterfly valves 32, 33 can be obtained by suitably profiling the cam 29.

The fan 4 described is economical of driving power, and has the characteristic that the more it is throttled the less power is required. Thus it may not be necessary to switch off the motor 7 when the car is travelling at speed and the butterfly valve completely throttles the output of the fan 4. However, if desired movement of the bellows wall 22 can be made to operate a control switch for the motor.

It is contemplated that cooling water from the car engine will normally be circulated in the heat exchanger 6. However, it may sometimes be desirable to use an alternative or supplementary source of hot water for the heat exchanger.

Vehicle heater/air conditioning units according to the invention can be made relatively flat and long, which is a convenient shape for installation in a vehicle: there is greater flexibility in design than with the axial-flow units hitherto common, since the rotor or rotors can be made any length. The fans described herein are particularly quiet and efficient: moreover such noise as may be produced can be minimized by forming a portion of the housing as a resonator. Noise

width of the housing 1. The guide wall 14 is part of the bottom wall 1*d* of the housing where it curves up towards the inlet 2. One limb of the baffle 17 co-operates with part of the base of the housing 1 further towards the rear to provide a diffuser 20 through which the air leaving the rotors passes.

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Vehicle heater/air conditioning units according to the invention can be made relatively flat and long, which is a convenient shape for installation in a vehicle: there is greater flexibility in design than with the axial-flow units hitherto common, since the rotor or rotors can be made any length. The fans described herein are particularly quiet and efficient: moreover such noise as may be produced can be minimized by forming a portion of the housing as a resonator. Noise

from the fans described has a well-defined main frequency and is thus readily silenced by this method.

WHAT WE CLAIM IS:—

1. A vehicle heater/air conditioner unit comprising: a housing having an inlet to face forwardly of the vehicle; an outlet for supply of air to the interior of the vehicle; a heat exchanger for heating air flowing between inlet and outlet; a fan in the housing; a by-pass past the fan; and flow control means in the housing sensitive to ram air pressure and effective, when the ram air pressure is zero, to block the by-pass and permit flow through the housing on operation of the fan, and, when the ram air pressure rises, to open the by-pass and permit flow through the housing by reason of ram air pressure.

2. A unit as claimed in Claim 1, wherein the housing has a pair of parallel side walls and top and bottom walls together defining said inlet at one end of the housing and a substantially rectangular cross-section transverse to the general direction of said air flow, and the fan comprises an electric motor-driven cylindrical bladed rotor means mounted for rotation about an axis parallel to the long sides of said rectangle and guide means co-operating with the rotor on rotation thereof to induce a flow of air twice through the path of the rotating blades of the rotor, the motor and rotor means occupying substantially the whole width of the housing between the side walls.

3. A unit as claimed in Claim 2, wherein the bottom housing wall provides a guide surface for the rotor means constituting part of said rotor means.

4. A unit as claimed in Claim 2 or Claim 3, wherein the side walls and top and bottom walls define a rectangular opening providing the inlet.

5. A unit as claimed in any of Claims 2 to 4, wherein the by-pass extends over the whole width of the housing between the side walls.

6. A unit as claimed in any of the preceding claims, wherein the flow control means includes first and second flap valves the first valve controlling the by-pass and the second valve flow through the fan, the valves being simultaneously controlled by a bellows subject to ram air pressure and arranged as ram air pressure rises to open the first valve and to close the second valve.

7. A unit as claimed in Claim 6, wherein the bellows is formed by the bottom wall and by a movable wall below the bottom wall and articulated thereto.

8. A unit as claimed in any of the preceding claims wherein the heat exchanger is provided with a by-pass therefor and a by-pass valve movable between a position where it obstructs flow through the heat exchanger and a position where it obstructs flow in the heat exchanger by-pass.

9. A unit as claimed in Claim 8, wherein the heat exchanger is downstream of the fan.

10. A unit as claimed in Claim 9, wherein the by-pass valve of the heat exchanger is on the downstream side of the heat exchanger.

11. A unit as claimed in any of the preceding claims including a filter in the housing movable between an operative position where it is in the path of air flow through the housing and an in-operative position where air flow takes place around the filter.

12. A unit as claimed in Claim 11, wherein the filter is angularly movable as a whole within the housing.

13. A unit as claimed in any of the preceding claims including a switch for the motor and means to actuate the switch on change of ram air pressure so that when the by-pass is open by a predetermined amount the motor is cut out.

14. The vehicle heater/air conditioner herein described with reference to the accompanying drawing.

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